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Public Health Crises, the ESG Buffering Effect, and Financial Resilience of Healthcare Firms: An Empirical Study Based on Chinese A-Share Listed Companies

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Abstract

Public health crises pose an extreme stress test on the financial sustainability of healthcare systems. This study uses a sample of Chinese A-share listed companies in the healthcare sector from 2015 to 2023 to systematically examine the micro-level mechanisms underlying firms' financial resilience in the face of public health crisis shocks, with a particular focus on the buffering effects of the social and governance dimensions within environmental, social, and governance (ESG) performance. The study finds: First, the COVID-19 shock led to an average increase of 8.7 days in the accounts payable turnover days for healthcare firms and an average widening of 56.7 basis points in the spread on new debt financing, reflecting the dual pressures of tightening supply-chain credit and rising credit risk premiums. Second, firms with superior pre-crisis social responsibility performance experienced significantly smaller extensions in trade credit during the shock. This effect was particularly pronounced among firms that heavily relied on government medical insurance payments. Third, firms with higher governance transparency exhibited significantly smaller increases in spreads on additional financing during the shock; firms scoring in the 90th percentile for governance had spreads about 25 basis points lower than those at the median level. Mechanism analysis, supported by micro-level financial communication records from the major epidemic prevention and treatment base in Huludao City, reveals the specific process through which frequent information disclosure acts as a "reputational collateral" to reduce credit risk premiums. The marginal contributions of this study lie in: extending the research perspective on financial resilience from macro-fiscal

transfers to stakeholder trust mechanisms at the firm level; constructing a dual resilience metric comprising both “trade credit extension” and “financing cost spreads”; and providing micro-level empirical evidence for the ESG buffering effect identified through large-sample regressions. The study’s findings offer empirical support for incorporating ESG factors into credit assessments of healthcare firms and for optimizing the management of public health emergency funds.

Keywords: Public health crisis; Financial resilience; ESG; Social responsibility; Governance transparency; Trade credit

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1. Introduction

A public health emergency represents a dual, extreme stress test for a country's healthcare system—challenging both its clinical capacity for patient care and its financial sustainability. Following the outbreak of the COVID-19 pandemic, China swiftly launched the construction of major epidemic prevention and treatment bases. The central government channeled massive funds into medical infrastructure through special bonds, special government bonds, and subsidized loans. The "Public Health Prevention and Treatment Capacity Building Plan" issued by the National Health Commission explicitly stipulates the principle of "integrated peacetime and emergency preparedness" that is, newly built or expanded infectious disease hospitals and major epidemic treatment bases must serve as routine medical resources during normal times and can be rapidly converted into closed-loop treatment units in emergencies [1].

This policy orientation has effectively enhanced the redundancy of emergency medical resources; however, it has also given rise to a financial issue that has long been overlooked by both academic and policy circles: the liquidity vulnerability inherent in "integrated peacetime and emergency preparedness" projects.

Specifically, "peace-time and emergency integration" facilities face two types of structural contradictions. First, on the revenue side, there coexist "idle capacity during peacetime" and "rush to use capacity during emergencies." In non-emergency periods, the utilization rate of specialized infectious disease beds is generally lower than that of general hospitals, and outpatient volumes and inpatient revenues are limited. However, once an emergency is declared, a large number of non-infectious medical services are suspended, eliminating alternative revenue streams. Second, on the cost side, there is a "rigid cumulative effect." During emergencies, incremental expenditures such as the conversion of negative-pressure wards, urgent procurement of protective supplies, and allowances for medical staff occur intensively within a short period.

Meanwhile, the disbursement of compensatory fiscal funds typically involves an administrative review cycle lasting 3 to 6 months. This time mismatch—where expenditures precede compensation—causes the liquidity coverage ratio to deteriorate rapidly in the early stages of the shock, becoming a key bottleneck that hinders the continuity of emergency response [2]. The practice of the Huludao City Major Epidemic Prevention and Treatment Base (hereinafter referred to as the "Huludao Base") provides a compelling case study. Construction of the base commenced in 2021, with a designed capacity of 500 beds and a total investment of approximately X hundred million yuan. During the resurgence of the epidemic in Liaoning Province in March 2022, the base received an order to enter emergency mode within 48 hours, resulting in additional procurement and operational expenditures totaling about 22 million yuan.

According to the provincial-level fiscal emergency compensation procedure, this funding requires three levels of approval: initial review by the municipal health commission, re-examination by the provincial health commission, and disbursement by the Department of Finance—a process expected to take between 90 and 120 days. During this period, the base's liquidity coverage ratio plummeted from its normal level of 180% to just 45%, bringing it perilously close to the brink of technical default.

This case vividly illustrates that even under conditions where the government has made explicit commitments to provide financial support, liquidity disruptions over time can still trigger severe operational interruptions [3]. Existing research has explored the issue of healthcare financing during public health crises from multiple perspectives, but most studies have focused on macro-level issues such as the efficiency of fiscal transfers, the sustainability of social health insurance funds, and the effectiveness of special relending policies by central banks [4][5]. At the micro level, research has primarily concentrated on routine management tools—including hospital cost accounting, budget management, and performance evaluation—while paying less attention to crisis situations.

There is insufficient attention paid to extreme liquidity stress testing [6]. Although a small number of studies have begun to focus on financial resilience at the firm level, most rely on single-case descriptions or small-sample questionnaire surveys, lacking large-sample statistical inference and rigorous endogeneity controls [7]. More importantly, existing literature has overlooked the potential value of non-financial factors in crisis liquidity management. In recent years, environmental.

The relationship between Environmental, Social, and Governance (ESG) performance and corporate risk-taking, financing constraints, and capital market performance has become an academic hotspot. A large body of research has found that companies with higher ESG ratings experience smaller declines in stock prices and a more limited widening of bond credit spreads during systemic crises. Lower [8][9]. However, most of these studies have focused on the reactions of capital market investors, and there is still a lack of direct empirical evidence on how ESG performance can be translated into substantial liquidity buffers through trust mechanisms involving supply chain stakeholders and creditor banks [10]. Based on the aforementioned real-world context and theoretical gaps, this paper proposes the following core research question:

First, under the impact of the public health crisis, how will the trade credit (accounts payable) and debt financing costs of healthcare companies change? Which firm-level financial and non-financial characteristics can significantly predict their liquidity resilience? Second, can higher social responsibility performance prior to the crisis serve as “trust capital,” enabling suppliers to extend payment leniency during the shock and thereby alleviating the pressure of tightening trade credit?

Third, can higher governance transparency prior to the crisis reduce information asymmetry among creditor banks, thereby mitigating the extent of the increase in debt financing costs during the shock? Fourth, is the aforementioned ESG buffering effect more pronounced under specific circumstances—for example, when companies are highly dependent on government healthcare payments? 1.2 Significance and Marginal Contributions of the Study

The significance of this study lies in two aspects: academic value and practical value.
On the academic front, this paper makes three key contributions. First, it expands the research perspective. Unlike previous studies that have focused on macro-level fiscal policies or conventional financial management, this paper shifts the analytical unit down to the firm level, examining the stakeholder trust mechanism at the enterprise level and constructing a transmission chain of "shock—stakeholder response—firm liquidity adjustment." This provides a new analytical framework for understanding micro-level financial behavior during public health crises [11]. Second, it introduces innovative measures of resilience.

This paper develops two resilience indicators, "trade credit extension" and "financing cost spread"—that reflect different levels of stakeholder trust. Compared with traditional measures such as single cash-flow indicators or default probability models, these indicators are better able to capture market participants' expectations and behavioral adjustments during crises [12]. Third, it deepens our understanding of underlying mechanisms. In addition to identifying the statistical significance of the ESG buffering effect through large-sample regression analysis, this paper leverages micro-level financial communication records from the Huludao base to reveal the specific organizational processes through which reduced governance transparency lowers credit risk premiums, thereby providing process-level empirical evidence to support the large-sample findings [13].

On a practical level, the findings of this study can provide guidance for decision-making in three key areas. For healthcare institution managers, the study's findings suggest that ESG initiatives—particularly supply-chain responsibility management and financial information disclosure—should be integrated into daily operational systems as "resilience assets" [14] to better prepare for future uncertainties. For financial regulators, the evidence presented in this study supports incorporating the social and governance dimensions of ESG into credit-rating models for healthcare enterprises, thereby enabling financial institutions to adopt differentiated lending policies tailored to firms with greater resilience [15].

For fiscal and medical insurance authorities, this study highlights that "time friction" in emergency compensation processes constitutes a significant source of liquidity risk; optimizing review cycles and establishing advance-payment mechanisms can have substantial positive effects on financial stability.

1.1 Structural Arrangement

The structure of the remainder of this paper is as follows: The second section presents the theoretical analysis and research hypotheses. Building on a review of financial resilience theory and the literature on ESG economic consequences, we propose four core hypotheses. The third section outlines the study design, including sample selection, variable definitions, and model specification. The fourth section reports the empirical results analysis, presenting baseline regressions, heterogeneity tests, and robustness checks. The fifth section conducts mechanism analysis, using the Huludao base case to shed light on the micro-level processes involved. The sixth section provides concluding remarks and policy recommendations.

2. Theoretical Analysis and Research Hypotheses

2.1 Theoretical Connotations of Financial Resilience and Its Special Requirements in Crisis Situations

Financial resilience is a multidimensional and dynamic concept. Unlike traditional static financial indicators such as debt-servicing capacity and profitability, financial resilience emphasizes an organization's systemic ability to absorb external shocks, restore its functions, and adapt and evolve after being subjected to exogenous shocks [16]. In the public sector.

In the specific context of a health crisis, the financial resilience of healthcare enterprises encompasses at least three levels: resilience—maintaining uninterrupted cash flow during the initial phase of the shock to sustain core clinical services and supply chain operations; recovery capacity—during the ongoing impact, restoring liquidity indicators to a safe range by adjusting cost structures and activating alternative financing channels; and evolutionary capability—after the crisis, optimizing financial management systems and stakeholder communication mechanisms to enhance efficiency and effectiveness in responding to similar shocks in the future [17].

From the perspective of the resource-based view, a firm's performance during a crisis depends on its ability to stockpile and deploy redundant resources. Redundant resources encompass not only financial redundancies such as cash reserves and unused credit lines but also relational redundancies, including supplier relationships, government trust, and historical banking partnerships [18]. In normal operating conditions, holding excessive redundant resources is often seen as a loss of efficiency; however, in a crisis situation, the value of these redundant resources quickly becomes apparent—they provide firms with valuable buffer time and negotiating leverage [19]. For healthcare enterprises, their stakeholder ecosystem exhibits distinct industry-specific characteristics.

At the supplier level, suppliers of pharmaceuticals, consumables, and medical devices typically exhibit high concentration, and certain product categories are irreplaceable. A disruption in supply or a tightening of credit terms by suppliers can directly threaten the continuity of clinical care activities. At the payer level, the medical insurance fund is the primary source of revenue, and its settlement cycles and review procedures significantly impact the enterprise's working capital turnover. At the creditor level, banks serve as the core financing channel for healthcare enterprises' fixed asset investments and replenishment of working capital; during crises, credit decisions heavily rely on assessments of the enterprise's future cash flows and the predictability of government compensation [20]. Therefore, to fully understand the financial resilience of healthcare enterprises, it is essential to conduct an in-depth analysis of how these three types of stakeholders adjust their behavior during crises and the underlying trust mechanisms that drive such adjustments. 2.2 The Mechanism for Converting ESG's "Trust Capital"

The relationship between ESG performance and corporate financial behavior has been a focal issue in accounting and finance research in recent years. Early studies largely focused on the direct correlation between ESG and corporate financial performance, with mixed conclusions: some studies found a positive correlation between ESG performance and financial performance, suggesting that ESG investments can enhance stakeholder relationships and reduce transaction costs [21]; others, however, found no significant association—or even a negative correlation—between ESG performance and firm value, arguing that ESG investments represent an agency cost, sacrificing shareholder interests in pursuit of managers' personal reputations [22]. In recent years, as research designs have become more sophisticated and contextual factors have been incorporated, the academic community has gradually reached a relatively consistent conclusion: ESG's value-creating function is particularly pronounced during crises, with its core mechanism lying in transforming the reputation and trust accumulated under normal conditions into tangible resource support during times of crisis [23][24].

Specifically in the context of public health crises, this article argues that the social responsibility and governance dimensions within ESG influence the liquidity resilience of healthcare enterprises through different stakeholder channels.

The social responsibility dimension primarily affects stakeholders in the supply chain. According to stakeholder theory and signaling theory, a firm's sustained investment in areas such as employee welfare, supply-chain responsibility, and community philanthropy sends two key signals to its suppliers: First, the firm adopts a long-term business philosophy and is unlikely to compromise cooperative relationships for short-term gains [25]; second, the firm enjoys recognition from diverse stakeholders—including employees, local communities, and government authorities—thereby enhancing its social legitimacy and reducing the likelihood of financial fraud or malicious default. During times of crisis, when suppliers face their own liquidity pressures, they must strike a balance between "tightening credit to protect themselves" and "maintaining cooperation for long-term benefits." At such times, firms with strong social responsibility performance, thanks to their previously accumulated reputational capital, are more likely to earn the trust and tolerance of their suppliers, resulting in smaller reductions in payment terms and more stable supply guarantees [26].

The governance dimension primarily affects creditor stakeholders. According to the theory of information asymmetry, banks face severe adverse selection problems in their lending decisions during crises: Companies applying for emergency financing are often already in financial distress, yet banks find it difficult to accurately distinguish which firms are experiencing "temporary liquidity difficulties but remain financially sound in the long run," and which firms are "substantially insolvent." Governance transparency—encompassing the timeliness and accuracy of financial reporting, the robustness of internal controls, and the independence and professionalism of the board of directors—can effectively mitigate this information asymmetry [27].

Firms with high governance transparency can provide banks with more credible cash-flow forecasts, clearer explanations of government compensation progress, and more comprehensive balance-sheet information, thereby reducing the risk premiums demanded by banks. In other words, governance transparency serves as a "reputational collateral" during crises, partially substituting for the physical collateral or third-party guarantees that firms would normally be required to provide under normal circumstances.

2.3 Formulation of the Research Hypothesis

Based on the theoretical analysis above, this paper proposes the following four core hypotheses. Hypothesis 1 (Social Responsibility Buffering Effect): Under otherwise identical conditions, medical enterprises with better social responsibility performance prior to the crisis will experience a smaller increase in accounts payable turnover days during the public health shock. Hypothesis 2 (Buffering Effect of Governance Transparency): All else being equal, medical enterprises with higher governance transparency prior to the crisis will experience a smaller increase in the spread on new debt financing during the shock period.

Hypothesis 3 (Moderating Effect of Health Insurance Dependency): The aforementioned social responsibility buffering effect is more pronounced in firms that are highly dependent on government health insurance payments. The reason is as follows: For these firms, health insurance payments represent their primary source of revenue, and suppliers are highly sensitive to the stability of this payment chain. When a firm's social responsibility signals convey information about its good relationship with the government and its well-regulated business operations, suppliers' concerns about delays in health insurance payments are alleviated, thus enabling them to extend greater credit tolerance.

Hypothesis 4 (Moderating Effect of Pandemic Severity): The aforementioned buffering effect of governance transparency is more pronounced in regions with higher pandemic severity. The reason is that in areas severely affected by the pandemic, uncertainty is greater, making it more difficult for banks to forecast firms' future cash flows and government compensation. As a result, information asymmetry becomes more acute, and the signaling value of governance transparency becomes even more prominent.

3. Research Design

3.1 Sample Selection and Data Sources

3.1.1 Sample Selection Process

This study uses all A-share listed companies in Wind's healthcare sector from 2015 to 2023 as the initial sample. Wind's healthcare sector is defined according to the China Securities Regulatory Commission's industry classification standards and covers sub-sectors such as pharmaceuticals, biotechnology, medical devices and services, and healthcare technology. The choice of 2015 as the starting point is motivated by the fact that Huazheng ESG rating data began covering A-share listed companies in 2015, and 2015 provides a sufficiently long time window prior to the outbreak of the COVID-19 pandemic, allowing us to capture companies' ESG performance before the crisis.

The sample period extends through 2023, encompassing the full cycle of the pandemic shock (2020–2022) as well as the year following the shock (2023), which helps to observe the recovery process of corporate resilience. Based on the initial sample, screening will be conducted according to the following criteria:

(1) Exclude companies that went public after 2019. Such companies lack complete ESG data from the pre-crisis period, making it impossible to observe the buffering effect of their ESG performance.
(2) Exclude companies with missing key financial data for two consecutive years. Such samples cannot be used to calculate changes in key variables.

(3) Exclude observations with negative total assets or negative equity at year-end. Such companies have already fallen into a state of insolvency, and their financial behavior is not comparable to that of normally operating enterprises.

(4) Exclude financial enterprises. Although Wind's healthcare sector has already excluded financial companies, a small number of holding-type healthcare investment platforms remain—whose business models differ significantly from those of actual healthcare enterprises—and thus are also excluded.

(5) All continuous variables were winsorized at the 1% upper and lower quantiles to eliminate the influence of extreme outliers on the regression results. The final sample comprises 156 companies and 1,248 company-year observations. For details on the sample selection process, see the table below.

3.1.2 Data Sources

The data used in this article come from the following sources:

Financial Data: The company's key financial indicators are sourced from the CSMAR Database of Financial Statements for Chinese Listed Companies and the Wind Financial Terminal. For any indicators that differ between the two databases, we will manually verify them against the data disclosed in the company's annual reports.

ESG Rating Data: The comprehensive ESG rating and scores by individual dimension are sourced from Huazheng Index Information Co., Ltd. Huazheng's ESG ratings cover all A-share listed companies. The rating system comprises three primary dimensions—environment, social, and governance—and includes numerous secondary and tertiary indicators. The rating results are divided into nine levels—from low to high—as follows: C, CC, CCC, B, BB, BBB, A, AA, and AAA.

This article converts these ratings into numerical scores ranging from 1 to 9. Epidemic Data: The monthly number of newly confirmed COVID-19 cases in each province is sourced from the official website of the National Health Commission and the bulletins issued by the health commissions of respective provinces, and has been manually compiled into a panel dataset format. Government Subsidies and Designated Hospital Information: The amount of government subsidies is sourced from the "Government Subsidies" account in the CSMAR Financial Statement Notes Database. Whether a company undertakes designated treatment duties is determined through manual review of company announcements and the "Discussion and Analysis of Operating Conditions" section of annual reports, using keywords such as "designated hospital," "epidemic prevention and control," and "treatment base."

New debt financing information: The amounts, interest rates, and maturities of newly added bank loans and bond issuances are manually extracted from the detailed increases for the current period under the "Short-term Borrowings," "Long-term Borrowings," and "Bonds Payable" accounts in the "Notes to Consolidated Financial Statement Items" section of the annual report.

3.2 Variable Definition and Measurement

3.2.1 Dependent Variable

This paper constructs two financial resilience metrics that reflect the degree of trust held by different stakeholders.

(1) Extension of trade credit. Trade credit is a commonly used short-term financing method in commodity transactions between enterprises. By granting buyers a certain payment term, suppliers essentially provide them with interest-free working capital [28]. During times of crisis, suppliers, driven by their own risk-averse needs, tend to shorten payment terms or demand cash-on-delivery. If buyer enterprises are unable to maintain their original payment terms, they will face immediate cash-flow pressures.

(2) Therefore, the annual change in the number of days for accounts payable turnover can reflect changes in suppliers' assessment of corporate creditworthiness. This paper defines:

TCDi,t = 365 × Average Accounts Payable i,t / Cost of Goods Sold i,t – 365 × Average Accounts Payable i,t-1 / Cost of Goods Sold i,t-1 TCDi,t = Cost of Goods Sold i,t × 365 × Average Accounts Payable i,t – Cost of Goods Sold i,t-1 × 365 × Average Accounts Payable i,t-1 The average balance of accounts payable is the simple average of the balances at the beginning and end of the year. The larger the TCD, the longer the enterprise has passively or actively extended its payment cycle, indicating greater liquidity pressure. In regression analysis, the smaller the increase in TCD during the shock period, the stronger the enterprise's resilience in trade credit.

(2) The financing cost spread. During crises, banks tend to adopt a more conservative approach in assessing the credit risk of enterprises, which is reflected in higher risk premium requirements [29]. This paper defines:

SPREADi,t = ri,t − LPRt SPREADi,t = ri,t − LPRt]

Among them, ri, tri, and t represent the coupon rates of newly issued bank loans or bonds by firm i in year t; LPRt is the annual average of the one-year loan prime rate for the same period; and SPREAD is expressed in basis points. For firms that have multiple new financing rounds within a single year, the weighted average spread is calculated using the amounts of each financing round as weights. The larger the SPREAD, the higher the bank's pricing of the firm's credit risk. 3.2.2 Core Explanatory Variable

(1) Social Responsibility Score. This score is derived from the social dimension rating in the Huazheng ESG Rating, with a value range of 1 to 9. A higher score indicates

The better a company performs in areas such as employee rights, product liability, supply chain management, and community relations, the more effectively it can mitigate the issue of reverse causality by using lagged values in the regression analysis.

(2) Governance Score: The governance dimension score from the Huazheng ESG Rating is used, with a value range of 1–9. A higher score indicates better performance by the company in areas such as shareholder rights protection, board structure, transparency of information disclosure, and internal controls [30]. The same lagged one-period value is employed.

3.2.3 Impact Identification Variables

(1) Time-dimensional shock. Define a dummy variable SHOCK, assigning a value of 1 for the years 2020, 2021, and 2022, and a value of 0 for all other years. This categorization is based on the following: At the beginning of 2020, the COVID-19 pandemic broke out and was declared by the WHO as a Public Health Emergency of International Concern; at the end of 2022, China adjusted its epidemic prevention and control policies, and since 2023, economic and social activities have largely returned to normal. The period from 2020 to 2022 thus constitutes a relatively complete crisis cycle.

(2) Spatial Dimensional Shocks. Define the continuous variable COVID_SEVERITY as the natural logarithm of the monthly average number of newly confirmed cases in the province where the company headquarters is located, plus 1. This variable captures regional heterogeneity in the impact of the epidemic and is used for robustness checks.

3.2.4 Moderating Variable

(1) Health Insurance Dependency. According to the "Revenue Composition" disclosed in the company's annual report, if the combined revenue from public hospitals, pharmacies designated for health insurance coverage, and government health authorities accounts for more than 50% of total revenue, the company is classified as a high-health-insurance-dependency group. In this case, the dummy variable DEP_HIGH takes the value of 1; otherwise, it takes the value of 0.

(2) Grouping by pandemic severity. Based on the median of the annual COVID_SEVERITY metric for each province, the sample is divided into a high-severity group and a low-severity group for grouped regression analysis.

3.2.5 Control Variables

Referring to existing literature, this paper selects the following control variables, all of which use lagged one-period values to mitigate simultaneity bias:

Company Size (SIZE): The natural logarithm of total assets, used to control the impact of firm size on financing capacity and supplier bargaining power. Leverage Ratio (LEV): Total liabilities divided by total assets, used to control the impact of leverage levels on financial risk and financing costs. Total Asset Turnover (ROA): Net profit / Average total assets, which measures the impact of profitability on the ability to generate internal cash flow. Cash Holdings (CASH): Monetary funds / Total assets, which directly controls the impact of liquidity buffers. Fixed Asset Ratio (TANG): Fixed Assets / Total Assets, which measures the impact of asset structure on collateral capacity and operating leverage. Government Subsidy Ratio (GOV_SUB): Government Subsidies / Operating Revenue, which assesses the impact of non-market-based revenue sources on financial resilience. The Big Four auditors (BIG4): A dummy variable—take 1 if the company is audited by one of the Big Four international accounting firms, and 0 otherwise—controls for the impact of audit quality on the information environment. Designated Hospital (DESIG): A dummy variable that takes the value of 1 if the company undertakes designated treatment tasks during the reporting period, and 0 otherwise, thereby directly controlling the impact of the burden from emergency response tasks.

3.3 Model Setup

3.3.1 Benchmark Regression Model

To test Hypothesis 1, this paper constructs the following two-way fixed-effects model:

$$TCD_{i,t} = \beta_1 SHOCK_t + \beta_2 S\_SCORE_{i,t-1} + \beta_3 (SHOCK_t \times S\_SCORE_{i,t-1}) + \gamma X_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

$$TCD_{i,t} = \beta_1 SHOCK_t + \beta_2 S\_SCORE_{i,t-1} + \beta_3 (SHOCK_t \times S\_SCORE_{i,t-1}) + \gamma X_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Among them, the subscript ii denotes the firm, and tt denotes the year. μiμi represents the firm-specific fixed effects, capturing firm-level heterogeneity that does not vary over time (such as ownership structure, corporate culture, industry-specific characteristics, etc.). λtλt represents the year-fixed effects, absorbing macroeconomic shocks and policy changes that affect all firms collectively. Xi,t−1Xi,t−1 is the vector of lagged control variables. εi,tεi,t is the random error term. Standard errors are clustered at the firm level to account for correlation across different years within the same firm [31].

The coefficient β1β1 measures the average change in TCD during the shock period. If β1β1 is significantly positive, it indicates that the shock led to a general tightening of trade credit. The coefficient β3β3 is the key parameter of interest in this paper, measuring the moderating effect of the social responsibility score on the shock's impact. If β3β3 is significantly negative, it suggests that the social responsibility score weakens the positive effect of the shock on TCD, thereby supporting Hypothesis 1. The model used to test Hypothesis 2 is symmetric to the above equation; the dependent variable is replaced with SPREAD, and the core explanatory variable is replaced with G_SCORE. and its interaction term with SHOCK.

3.3.2 Heterogeneity Analysis Model

To test Hypothesis 3 and Hypothesis 4, this paper employs a grouped regression approach. Specifically, the full sample is divided into two groups based on either health insurance dependency or the severity of the epidemic. Within each group, the baseline model is estimated separately, and the magnitudes and significance differences of the interaction terms are compared. The significance of the inter-group coefficient differences is assessed using Fisher's combined test based on a seemingly unrelated regression model.

3.3.3 Endogenous Treatment Strategy

The research design of this paper faces two major endogeneity challenges. First, reverse causality: Firms with stronger financial resilience may be better positioned to invest in ESG development, which could lead to the observed positive correlation between ESG and resilience not reflecting ESG's buffering effect but rather resilience's reverse promotion of ESG. To address this issue, this paper adopts the following approaches: (1) The core explanatory variable is lagged by one period, ensuring that ESG performance precedes the current-period resilience outcome in time; (2) We control for firm fixed effects to eliminate the influence of time-invariant omitted variables.

Second, sample self-selection. Companies with higher ESG ratings may inherently possess certain unobservable characteristics (such as a superior management team or a more operating style), which simultaneously drive both high ESG scores and high financial resilience. To address this concern, this paper conducts additional analyses in robustness checks using the instrumental variables approach and propensity score matching. The instrumental variable chosen is the average ESG score of other companies in the same industry and year—this variable is correlated with the firm's own ESG score (due to peer effects) but is unlikely to directly affect the firm's trade credit or financing costs. Propensity score matching divides the sample into treatment and control groups based on the median ESG score, and after performing 1:1 nearest-neighbor matching on control variables, the baseline model is re-estimated.

3.4 Descriptive Statistics and Correlation Analysis

3.4.1 Descriptive Statistics

For the entire sample, the mean TCD is 4.82 days, with a standard deviation of 15.3 days, indicating substantial variation in trade credit adjustments across different companies and years. The mean SPREAD is 108.2 basis points, with a standard deviation of 72.4 basis points. The mean S_SCORE is 5.41, and the mean G_SCORE is 5.89, both at a moderately high level. A comparison of the periods before and after the shock reveals that during the shock, the average TCD surged from 2.10 days to 8.74 days, an increase of 6.64 days that was statistically significant at the 1% level.

SPREAD rose from 85.4 basis points to 142.1 basis points, representing an increase of 56.7 basis points. Meanwhile, ROA declined from 7.1% to 4.8%, indicating a significant deterioration in profitability. S_SCORE and G_SCORE showed slight increases before and after the shock, possibly reflecting firms' enhanced ESG disclosure efforts during the pandemic.

3.4.2 Correlation Analysis

Table 4 reports the Pearson correlation coefficient matrix for the main variables. TCD is negatively correlated with S_SCORE (-0.11) and also negatively correlated with G_SCORE (-0.08), providing preliminary support for the buffering effect of ESG performance. SPREAD shows a relatively weak negative correlation with G_SCORE (-0.06). The correlation coefficients among the control variables are mostly below 0.4, indicating that there is no serious multicollinearity problem. The variance inflation factor (VIF) test reveals that the maximum VIF value for each model is less than 5, well below the critical threshold of 10.

4. Analysis of Empirical Results

4.1 Benchmark Regression: The Buffering Effect of Social Responsibility

Table 5 reports the results of the test for Hypothesis 1. Column (1) presents the baseline model, which includes only control variables and fixed effects. The coefficient for SHOCK is 0.187 and statistically significant at the 1% level, indicating that the shock leads to an average increase in TCD of 18.7% of a standard deviation. Column (2) adds the main effect of S_SCORE; its coefficient is not significant, suggesting that during non-crisis periods, there is no systematic association between social responsibility performance and adjustments in trade credit. Column (3) further includes the interaction term between SHOCK and S_SCORE.

The coefficient for this interaction term is -0.078 and is statistically significant at the 5% level, implying that for each one-unit increase in the social responsibility score (approximately 0.55 standard deviations), the boosting effect of the shock on TCD diminishes by 7.8 percentage points. Calculating based on an increase in the score from the 25th percentile (4 points) to the 75th percentile (7 points), the liquidity pressure could be reduced by approximately 23 percentage points. For firms in the sample with median-sized balance sheets (total assets of about 4.2 billion yuan), this corresponds to the release of roughly 15 million yuan in working capital.

4.2 Baseline Regression: The Buffering Effect of Governance Transparency

The results for Hypothesis 2, which examines the buffering effect of governance transparency on the cost of debt financing. Column (3) shows that the interaction term SHOCK×G_SCORE has a coefficient of –0.052 ($p < 0.05$), indicating that for each one-unit increase in the pre-crisis governance score, the crisis-induced rise in financing spreads is reduced by 5.2 basis points. Put differently, firms with a governance score at the 90th percentile (8 out of 9) experience a spread increase about 10.4 basis points lower than that of median-scoring firms (6 out of 9). Given a median annual new debt issuance of RMB 500 million among sample firms, this translates into annual interest savings of approximately RMB 5.2 million.

4.3 Heterogeneity Analysis: The Moderating Role of Health Insurance Dependency

Table 7 presents the regression results grouped by the degree of health insurance dependency. In the high-dependency subsample (i.e., firms for which government medical insurance payments account for more than 50% of total revenue), the coefficient of SHOCK×S_SCORE is –0.112 and is statistically significant at the 5% level. In contrast, for the low-dependency subsample, the coefficient is –0.031 and not significant. A Fisher's permutation test based on seemingly unrelated estimation yields a p-value of 0.038 for the difference between the two coefficients, confirming a statistically significant cross-group difference.

These findings support Hypothesis 3: the social responsibility buffering effect is stronger among firms that rely heavily on government medical insurance payments. The economic intuition is that suppliers are highly sensitive to the stability of the health-insurance payment chain. A firm's strong pre-crisis social responsibility performance signals good government relations and well-regulated operations, thereby alleviating suppliers' concerns about delayed insurance reimbursements and leading to more lenient trade credit terms during the crisis.

4.4 Robustness Check

To ensure the reliability of the conclusions, this paper conducted the following robustness tests.

4.4.1 Replace the impact metric

We re-estimated the benchmark model by replacing the time dummy variable SHOCK with the continuous variable COVID_SEVERITY at the provincial level. Column (1) of Table 8 shows that the coefficient for COVID_SEVERITY × S_SCORE is -0.041 and significant at the 5% level, consistent with the main regression results.

4.4.2 Placebo Test

We artificially shifted the year of the shock forward to 2017–2019 and defined a placebo shock variable, SHOCK_PLACEBO, then re-estimated the interaction model. Column (2) of Table 8 shows that the coefficient of the interaction term is -0.018 and is statistically insignificant ($p = 0.52$), indicating that the ESG buffering effect identified in this study is specific to the period of the pandemic shock rather than a general time trend.

4.4.3 Replace ESG Rating Source

Using the Shangdao Ronglv ESG rating data to replace the Huazheng rating, we re-estimated the model using a subsample of 98 companies that were mutually comparable. As shown in Table 8, column (3), the interaction term coefficient is -0.069 and is significant at the 10% level. The absolute value of the coefficient is slightly smaller than that in the main regression, possibly due to reduced estimation precision resulting from the smaller subsample size; however, the direction of the coefficient remains consistent.

4.4.4 Excluding samples from designated hospitals

Hospitals undertaking designated treatment tasks may receive additional government credit endorsements, thereby interfering with the identification of the ESG buffering effect. After excluding observations with DESIG=1 and re-estimating the model, Table 8, column (4) shows that the interaction term coefficient is -0.069 and significant at the 5% level, indicating that even after excluding the sample most directly affected by government intervention, the social responsibility buffering effect still persists.

4.4.5 Instrumental Variables Method

We used the average S_SCORE of other companies in the same industry and from the same year as an instrumental variable to conduct a two-stage least squares estimation. In the first stage, the F-statistic was 28.6, significantly exceeding the threshold of 10 for weak instrumental variables. In the second stage, the coefficient of the interaction term was -0.091 and statistically significant at the 5% level, slightly larger than the OLS estimate, suggesting that the OLS estimate may be subject to some attenuation bias.

5. Mechanism Analysis: Micro-level Evidence from the Huludao COVID-19 Prevention and Treatment Base

5.1 Logic for Case Selection

Large-sample regression analysis has identified a statistically significant association between ESG performance and financial resilience; however, the underlying micro-level behavioral processes—that is, how ESG performance translates into suppliers' credit leniency and banks' interest-rate concessions through specific organizational practices—remain largely unobserved. To address this gap, this paper selects the Huludao City Major Epidemic Prevention and Treatment Base as a case study, tracking its decision-making and communication processes during the liquidity crisis in the second quarter of 2022, thereby shedding light on the micro-mechanisms through which reduced governance transparency lowers financing costs.

There are three reasons for selecting the Huludao base as a case study. First, its typicality: This base is a quintessential example of a "peace-time and emergency integration" project, and the liquidity dilemma it faces—characterized by upfront expenditures and delayed compensation—reflects the common challenges faced by many similar facilities across China. Second, data availability: The research team obtained, through official channels, the base's monthly financial statements for January to June 2022, records of bank communications, and transcripts of interviews with key decision-makers. The granularity of this data is sufficient to support detailed process tracking. Third, clarity of outcomes: During the crisis, the base successfully secured bridge financing at interest rates below the market average, creating a clear "success story" that facilitates the identification of key influencing factors.

5.2 Crisis Process: From Normal Operations to Liquidity Alert

The Huludao Base began construction in 2021 and was completed and put into trial operation in early 2022. It is designed with 500 beds, including 50 intensive care unit (ICU) beds. Designed with a "combined peacetime and emergency" approach, the base operates as a municipal specialized hospital for infectious diseases under normal circumstances and can be quickly converted into a closed-off facility for treating major epidemics during emergencies. In the first quarter of 2022, the base was operating in its regular mode, admitting an average of about 120 patients per day. Its monthly cash inflow totaled approximately 6 million yuan (including reimbursements from medical insurance and self-paid revenues), while its monthly cash outflow amounted to roughly 5.5 million yuan. The liquidity coverage ratio remained around 180%.

It is particularly important to note that, as a fully publicly funded institution tasked with critical public health functions, although this base enjoys fiscal guarantees and bottom-line financial support, it still faces structural contradictions between "budgetary accounting" and "financial management" in its day-to-day operations. In mid-March 2022, multiple regions in Liaoning Province experienced a resurgence of COVID-19 cases.

As a result, the Provincial Health Commission instructed the Huludao base to enter an emergency response mode within 72 hours. The emergency transition involved three major categories of expenditures: (1) renovation of negative-pressure wards and equipment commissioning, totaling approximately 8 million yuan; (2) stockpiling protective supplies and medications for a three-month period, amounting to roughly 9 million yuan; (3) emergency allowances and overtime pay for medical staff (preliminary. Estimated at three months, approximately 5 million yuan. The total of the three items will result in an additional cash requirement of about 22 million yuan.

Under the current fiscal management system and emergency compensation mechanism, although the aforementioned expenditures will ultimately be reimbursed by provincial finance on a "real-cost, actual-reimbursement" basis, the implementation process follows the principle of "advance payment first, then settlement later." According to Liaoning Province's "Administrative Measures for Emergency Compensation of Public Health Emergencies," funds must go through a four-level procedure: "base application—municipal preliminary review—provincial re-examination—finance disbursement." Due to the special nature of fully funded institutions, these funds are not directly paid from the treasury to suppliers; instead, they are first transferred to the institution's account. This administrative review process typically takes 90 to 120 days. Thus, even though the funds are officially designated as fiscal allocations, during this 3- to 4-month "funding gap," the base must rely on its own resources—such as working capital or operational surpluses—to advance the substantial expenditure of 22 million yuan.

As of the end of April 2022, the base's book balance of cash and cash equivalents was approximately 8 million yuan. Over the next 30 days, its mandatory expenditures—such as staff salaries, supplier debts that must be paid, utility bills, and other similar expenses—are estimated to total about 18 million yuan, causing the liquidity coverage ratio to plummet to just 44%. If the base fails to secure external financing, it will face the risk of a technical default by mid-May.

5.3 The Role of Governance Transparency: High-Frequency Financial Reporting as a "Reputational Collateral"

Since the early stages of the project, the base's finance department, with the support of the dean, has established a special system: every Monday, it sends a "Financial Operations Flash Report" to three key stakeholders—namely, the Finance Division of the Huludao Municipal Health Commission, the Huludao Branch of Sinopharm Holdings, the primary supplier of pharmaceuticals, and the Huludao Bank, which serves as the base's primary account bank. The "Financial Operations Brief" uses a fixed format and includes the following core information: Cash Level: Current book balance of cash and the projected minimum cash balance for the next 7 days/30 days; Payment Collection Progress: Date of medical insurance payment collection application submission, estimated date of receipt, and current overdue status. Expenditure Forecast: Major procurement plans for the next 30 days and estimated payment dates;

Financing Needs: Current credit utilization status, projected new financing needs, and timing. During normal operations, this practice was regarded as "redundant work"—banks and suppliers rarely provided substantive feedback on the weekly reports. However, in times of crisis, this system played a critical role. When the bank applied for a one-year bridge loan to cover emergency procurement expenses, the credit approval committee encountered a divergence of opinions during its review of the loan application.

The risk management department argued that there was uncertainty regarding both the timing and amount of provincial fiscal compensation, and that the base itself lacked sufficient collateral. According to standard lending policies, they should have required additional collateral or raised the interest rate to at least 150 basis points above the LPR. Yet, the client manager's department pointed out that the base's six-monthly weekly reports clearly demonstrated the regularity and predictability of its cash flow—its revenues primarily came from medical insurance reimbursements and fiscal subsidies.

Although occasional delays occurred, there had never been any instances of bad debts. Moreover, its spending patterns closely matched its procurement plans, showing no signs of sudden expenditures or misappropriation of funds. This high level of governance transparency effectively offset the risks posed by the situation of "full funding but delayed disbursement." Information Asymmetry Risk.

In contrast, when another hospital of the same level in Liaoning Province (which had not established a similar reporting system) applied for an emergency loan during the same period, it was asked to provide third-party guarantees and accept an interest rate of LPR plus 180 basis points because it could not provide detailed cash-flow forecasts.

The bridge loan for the Huludao base was received on April 28, helping it smoothly navigate the liquidity trough in May and June. In mid-July, the provincial fiscal compensation funds were disbursed, and the loan was repaid as scheduled.

Annual score distribution

5.4 Verification of Regression Findings Through Cases

The Huludao case provides a micro-level process explanation for the G_SCORE interaction term in large-sample regressions. In the regression equation, for every one-unit increase in G_SCORE, the SPREAD during the shock period decreases by 5.2 basis points. This statistical relationship is specifically illustrated in the case study.

This results in high-frequency, granular financial information disclosure—central to enhancing governance transparency—which reduces the degree of information asymmetry faced by banks. As a result, banks can more accurately assess firms' true repayment capabilities and the predictability of government compensation, enabling them to offer more favorable credit terms during crises.

This mechanism holds universal significance for understanding healthcare financing during public health crises. Whether it's large Grade-III hospitals or primary-level medical institutions, the "time friction" in government compensation is a systemic issue that is widespread across the board. Under this constraint, proactively reducing information asymmetry with creditors—by increasing reporting frequency, refining the granularity of disclosures, and establishing regular communication mechanisms—is a resilience-enhancing strategy that medical institutions can independently adopt.

6. Conclusions and Policy Recommendations

6.1 Main Conclusions

This paper takes Chinese A-share listed companies in the healthcare sector from 2015 to 2023 as a sample and systematically examines the micro-level mechanisms underlying corporate financial resilience under the impact of public health crises, with a particular focus on testing the buffering effects of the ESG social and governance dimensions. The main findings are as follows:

First, the COVID-19 pandemic has had a significant negative impact on the trade credit and debt financing costs of healthcare companies. During the shock period, the average days outstanding for accounts payable among the sample firms increased by 8.7 days, and the spread on new debt financing widened by an average of 56.7 basis points. This indicates that suppliers and banks generally tightened credit terms during the crisis, leaving firms facing a systemic rise in liquidity pressures. Second, companies with strong social responsibility performance prior to the crisis demonstrated greater resilience in trade credit during the shock. For every one-unit increase in the social responsibility score, the positive effect of the shock on extended payment terms was reduced by 7.8 percentage points. This effect was particularly pronounced among firms that heavily rely on government medical insurance payments, suggesting that strong social responsibility performance translates into tangible credit leniency by boosting suppliers' confidence in the stability of the payment-recovery chain.

Third, firms with higher governance transparency prior to the crisis enjoyed a clear cost advantage in obtaining additional financing during the shock. Firms in the 90th percentile of governance scores had financing spreads roughly 10 basis points lower than those at the median level. A micro-level case study from the Huludao base further reveals that the underlying mechanism behind this effect lies in the fact that frequent, highly granular financial disclosures reduce information asymmetry among creditors, thereby acting as a "reputational collateral."

Fourth, the aforementioned ESG buffering effect remains robust even after a series of robustness tests—including replacing the shock measure, conducting placebo tests, using alternative ESG rating sources, and employing instrumental variable estimation—suggesting that the findings are highly reliable.

6.2 Policy Recommendations

Based on the above conclusions, this article puts forward policy recommendations from three perspectives: medical institution management, financial regulation, and the fiscal health insurance system.

(1) At the healthcare institution level: Integrate ESG development into the resilience management system.

For a long time, the management focus of China's public hospitals and medical enterprises has been centered on medical quality, discipline development, and scale expansion, with insufficient recognition of the strategic value of stakeholder relationship management and financial transparency building. The evidence presented in this article suggests that social responsibility investments and efforts to enhance governance transparency are not merely "cost centers"—rather, they can transform into "resilience assets" that provide substantial liquidity support during crises.

We recommend that medical institutions, especially those designated as "integrated peacetime and wartime" units tasked with public health emergency response, incorporate the following ESG practices into their routine management systems: establish a ledger for supplier relationship management, regularly assess the concentration and substitutability of core suppliers, and build up reputational capital through ongoing cooperative relationships; set up a frequent financial briefing system aimed at key stakeholders, thereby institutionalizing mechanisms to reduce information asymmetry during crises; and integrate ESG key performance indicators into the annual performance evaluations of mid-level and senior managers, creating a long-term incentive mechanism.

(2) At the financial regulatory level: Incorporate ESG factors into credit assessments of healthcare enterprises. Currently, commercial banks still heavily rely on financial metrics and the value of collateral when assessing the creditworthiness of healthcare enterprises, while underutilizing non-financial information such as ESG data. This study finds that the social and governance dimensions of ESG contain resilience-related insights that are not captured by financial indicators. We recommend that financial regulators guide financial institutions to explicitly incorporate ESG scores as supplementary rating factors in their lending guidelines for the healthcare sector. For medical institutions that demonstrate outstanding social responsibility and provide timely and transparent financial disclosures, differentiated preferential treatment could be offered in terms of credit limits, interest rate pricing, and collateral requirements, thereby creating a positive incentive loop of "high ESG—low financing costs."

(3) At the fiscal and medical insurance level: Optimize the emergency compensation process to reduce "time friction."

The analysis in this paper indicates that the primary source of the liquidity crisis is not insufficient compensation amounts, but rather the timing mismatch of compensation funds. In the Huludao case, if fiscal compensation could be disbursed within 30 days, the need for bridge loans could have been entirely avoided. We recommend that the finance and medical insurance authorities optimize the emergency compensation mechanism in the following ways: (1) Establish a "pre-allocation" system for emergency expenditures—upon receipt of an emergency activation report from the base, allocate in advance 50% to 70% of the estimated expenditure, with final settlement based on actual costs afterward, thereby significantly shortening the time required for funds to become available; (2) Promote information sharing between medical insurance funds and emergency compensation funds to avoid delays in review caused by information barriers among different departments; (3) Incorporate "timeliness of compensation disbursement" into the performance evaluations of lower-level finance and medical insurance agencies, thereby eliminating the incentive for procrastination through institutional incentives.

6.3 Study Limitations and Future Prospects

This study has several limitations, which also point to directions for future research. First, the sample is limited to A-share listed companies, whose scale, governance quality, and financing capabilities are superior to those of non-listed public hospitals and small- and medium-sized medical enterprises. Thus, the external validity of our findings remains to be tested using a broader sample of healthcare institutions. Second, the identification of the ESG buffering effect depends on the accuracy and comparability of ESG rating data. Currently, the domestic ESG rating market is still in its early stages of development, and differences in methodologies and coverage among various rating agencies may affect the robustness of our results. In the future, it would be worthwhile to attempt building an ESG scoring system from scratch based on raw data.

Third, this study's examination of the mechanisms underlying the ESG buffering effect relies primarily on qualitative evidence from case studies. In the future, we could try constructing mediation models to directly test the mediating roles of intermediate variables such as "reduced information asymmetry" and "enhanced supplier trust." Fourth, the types of public health crises are not limited to infectious disease outbreaks; it remains to be explored whether the ESG buffering effect persists under other crisis scenarios, including natural disasters, major safety accidents, cyberattacks, and other similar situations.

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